NuScale Power™

January 17th, 2017

NuScale Power Small Modular Reactors

Briefing to Idaho State Legislature Senate and House State Affairs Committees

Mike McGough
NuScale Power

Agenda

- DOE SMR Licensing Technical Support Program
- NuScale Technology Overview
- How Do We Know It Works?
- The Safety Case
- Commercialization Plan
- Q and A

NuScale Power™

Brief NuScale History

- NuScale first of current US SMRs to begin design of commercial NPP.
- NuScale technology in development and design since 2000 (DOE) MASLWR program, with INL, lessons from AP600/1000 ¼-scale testing facility built and operational
- Electrically-heated 1/3-scale integral test facility first operational in 2003
- Began NRC design certification (DC) pre-application project in April 2008, >22K Mhrs
- Acquired by Fluor in October 2011
- ~400 people currently on project, ~$500MM spent project life-to-date ($12MM/mo)
- >350 patents pending/granted, 19 countries
- Portland, Corvallis, Rockville, Charlotte, Richland, London
- US DOE SMR Awardee, 12/12/13, $217MM

NuScale Engineering Offices Corvallis, Oregon

One-third scale Test Facility

NuScale Control Room Simulator

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DCA Status-Completed 12/31/16

- Pre-application accomplishments
  - >130 meetings
  - 15 NRC audits and inspections
  - >1,000 documents on our docket
  - September Readiness Assessment
    - 84 NRC personnel
    - 8 working days
    - Cost >$1 Million
    - 85 docketing items identified
- 12,000 pages, 13.5 feet of bookshelf space
- 14 Topical Reports

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Final DCA Assembly and Submittal

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DCA Hand-off to NRC

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DCA Announcement PR Event – Jan. 12th

Speakers: John Hopkins, Chairman and CEO of NuScale Power; Mike McDaugh, Chief Commercial Officer of NuScale Power; Dr. Lynn Orr, Undersecretary for Science and Energy, U.S. Department of Energy; Maria Korsnick, CEO Nuclear Energy Institute; Members of Congress including Rep. Newhouse (R-WA 4th), Rep. Schrader (D-OR 5th), Rep. Stewart (R-UT 2nd), Rep. Veasey (D-TX 33rd), Rep. Wilson (R-SC 2nd)

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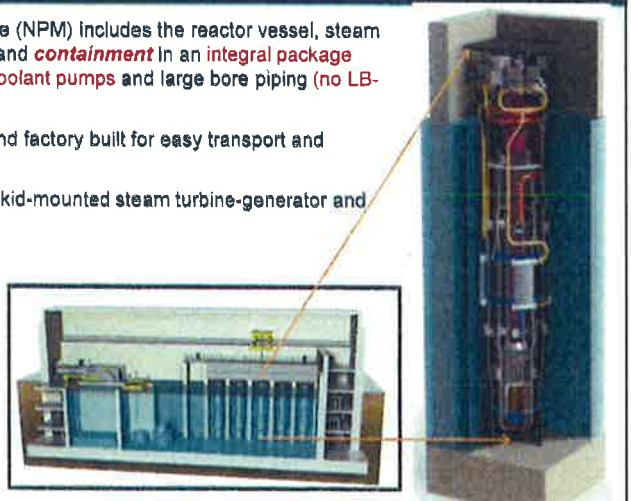
What is a NuScale Power Module?

- A NuScale Power Module (NPM) includes the reactor vessel, steam generators, pressurizer and ***containment*** in an integral package that eliminates reactor coolant pumps and large bore piping (no LB-LOCA)
- Each NPM is 50 MWe and factory built for easy transport and installation
- Each NPM has its own skid-mounted steam turbine-generator and condenser
- Each NPM is installed below-grade in a seismically robust, steel-lined, concrete pool
- NPMs can be incrementally added to match load growth - up to 12 NPMs for 600 MWe gross (~570 net) total output



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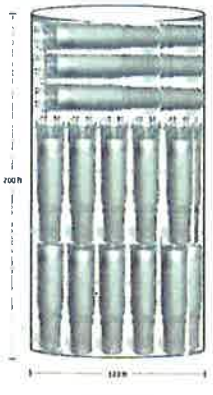
NuScale Technology Overview

Size Comparison

Comparison size envelope of new nuclear plants currently under construction in the United States

126 NuScale Power Modules



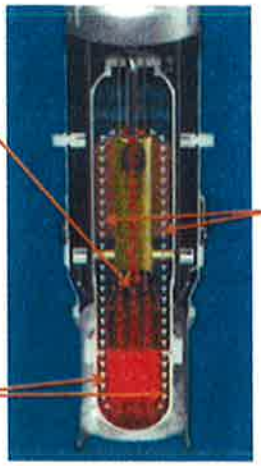
Containment

NuScale's combined containment vessel and reactor system

Typical Pressurized Water Reactor

Coolant Flow Driven By Physics

Convection – energy from the nuclear reaction heats the primary reactor coolant causing it to rise by convection and natural buoyancy through the riser, much like a chimney effect



Conduction – heat is transferred through the walls of the tubes in the steam generator, heating the water (secondary coolant) inside them to turn it to steam. Primary water cools.

Gravity – colder (denser) primary coolant "falls" to bottom of reactor pressure vessel, cycle continues

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How Do We Know It Works?

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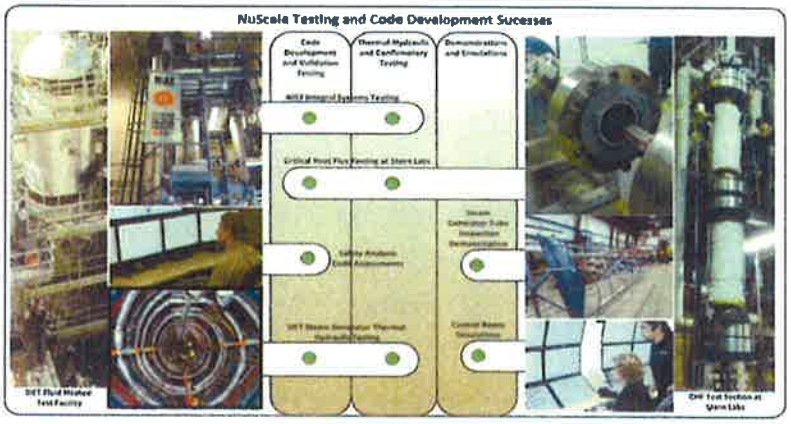
NuScale Reactor Qualification Test Plan

NuScale Reactor Qualification Test Plan outlines Design Certification and First Of A Kind Engineering (FOAKE) projects for reactor safety code development, validation, reactor design and technology maturation to reduce First Of A Kind (FOAK) design risk.



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Full Length SG Test (TF-2) Construction/Hardware

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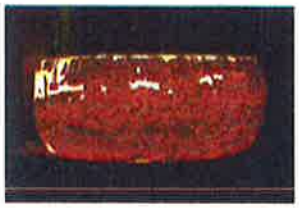
NuScale RPV Head Ingot Being Forged

- 150 inches diameter
- 30 inches high
- 142,000 pounds






Images Provided courtesy of Sheffield Forgemasters International Ltd

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Machining of the NuScale RPV Head


Images provided courtesy of Sheffield Forgemasters International Ltd

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Control Rooms

President Jimmy Carter briefed by James R. Floyd, supervisor of TMI-2 operations, with Harold R. Denton, director of the Office of Nuclear Reactor Regulation in the Nuclear Regulatory Commission. This control room design was complete in the late 1960s, before construction began in 1970.

In this April 29, 2015 photo, Chris Dujado, left, and Billy Horton, right, control room operators for Unit 2, review information from monitoring panels at the Watts Bar Nuclear Plant near Spring City, Tenn. The control room design is strikingly similar to those of the 1960s, despite innovations behind the panels. (AP Photo/Mark Zaleski)

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NuScale Power Control Room Simulator

The NuScale Power simulator control room design brings together decades of Digital I&C, Human Factors Engineering and Human Systems Interface research and field experience.

At a recent NuScale Family day, 10-year-old Sam Shore felt completely at home in the NuScale Control Room Simulator.

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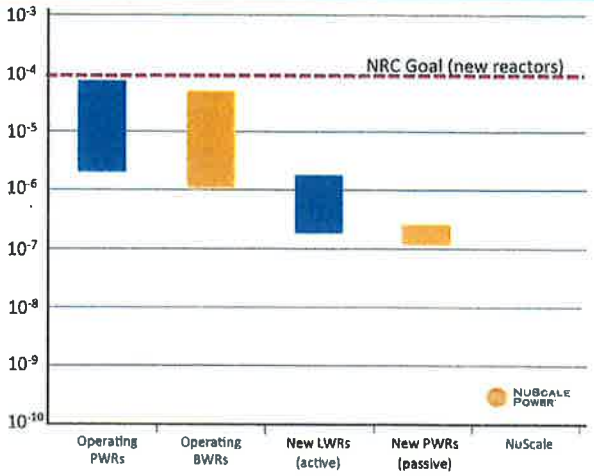
NuScale Control Room Simulator

The Safety Case

Core Damage Frequency Significantly Reduced



Source: NRC White Paper, D Dube; basis for discussion at 2/18/09 public meeting on implementation of risk metrices for new nuclear reactors

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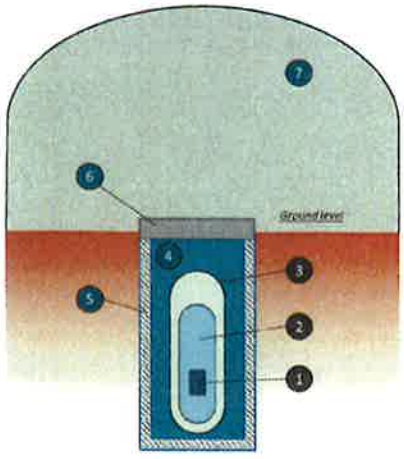
More Barriers Between Fuel & Environment

Conventional Designs

1. Fuel Pellet and Cladding
2. Reactor Vessel
3. Containment

NuScale's Additional Barriers

4. Water in Reactor Pool
5. Stainless Steel Lined Concrete Reactor Pool
6. Biological Shield Covers Each Reactor
7. Reactor Building



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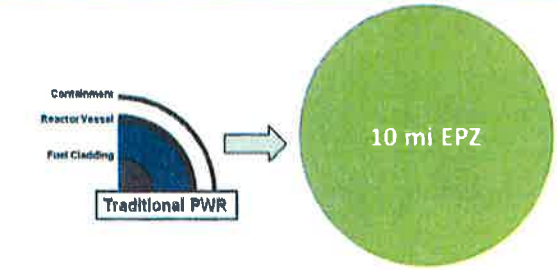
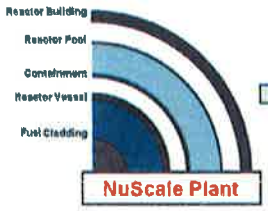
Smaller Emergency Planning Zone (EPZ) Due to Safer Design





Site Boundary EPZ
(depending on site characteristics)

- ***Passive Safety***
- ***Additional Fission Product Barriers***
- ***SignificantDelay in Release of Radiation***

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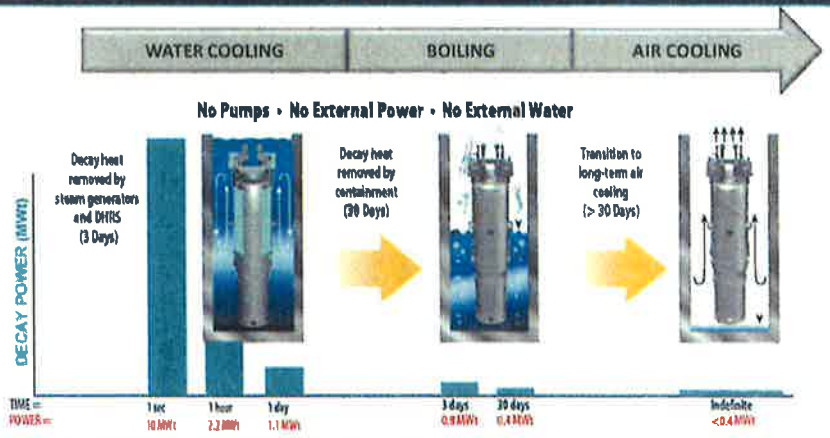
Innovative Advancements to Reactor Safety

Nuclear fuel cooled indefinitely without AC



- *30 days is a minimum based on very conservative estimates.*

**Alternate 1E power system design eliminates the need for 1E qualified batteries to perform ESFAS protective functions – Patent Pending*

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Commercialization Plan

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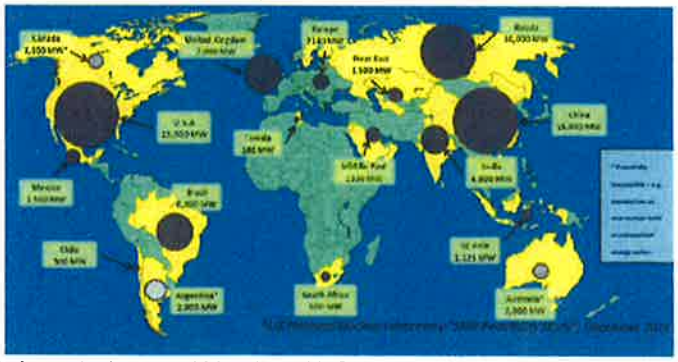
SMR Market Potential

- UK NNL* calculated the potential SMR market to be approximately 65-85GW by 2035, 55-75 GW excluding Russia



- This is equivalent to 1100 – 1500 NuScale Power Modules (NPMs)
- At 25% market share, and 10 year deployment timeframe, 28–38 NPM / year
- At 36 NPM / year, approximately 1000 workers dedicated to machining, assembling and testing NPMs

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NuScale Advisory Board (NuAB)

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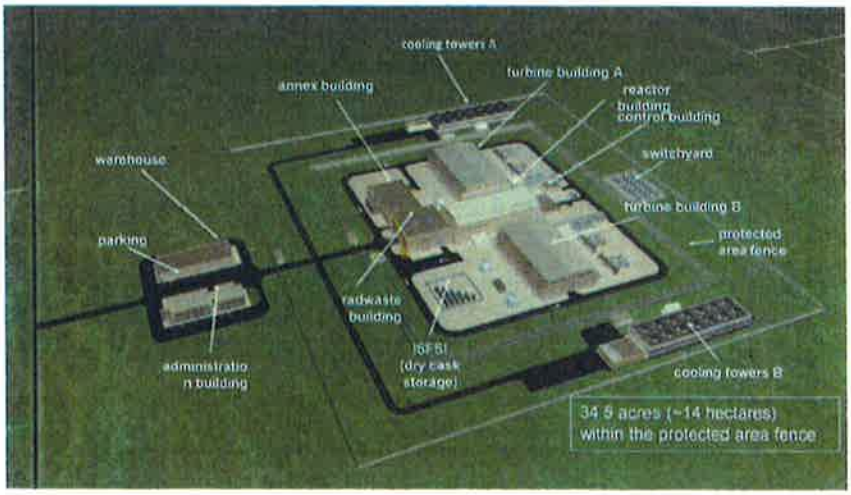
Site Overview



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Program WIN (Western Initiative for Nuclear)

- Western Initiative for Nuclear (WIN) is a multi-western state collaboration to deploy a series of NuScale Power Projects
- Involved Program WIN participants: NuScale, UAMPS, Energy Northwest, ID, UT, OR, WA, WY, AZ, NM, MT?, CO?

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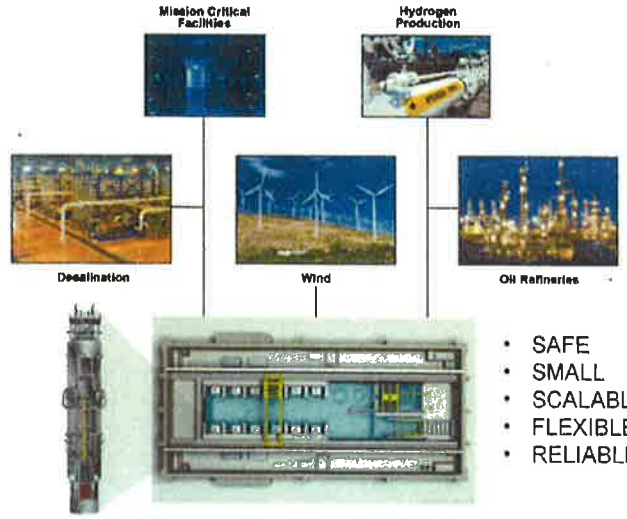
NuScale Diverse Energy Platform (NuDEP) Initiative



- SAFE
- SMALL
- SCALABLE
- FLEXIBLE
- RELIABLE

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NuScale/UAMPS/ENW Study on Integration with Wind Farm

- NuScale includes unique capabilities for following electric load requirements as they vary with customer demand and rapid output variations from renewables: NuFollow™
- There are three means to change power output from a NuScale facility:
  - Dispatchable modules – taking one or more reactors offline for extended periods of low grid demand or sustained wind output
  - Power Maneuverability – adjusting reactor power for one or more modules (intermediate time frames)
  - Turbine Bypass – bypassing turbine steam to the condenser (short time frames
- Explored integration with Horse Butte wind farm in Idaho
- Partnered with Utah Associated Municipal Power Systems and Energy Northwest

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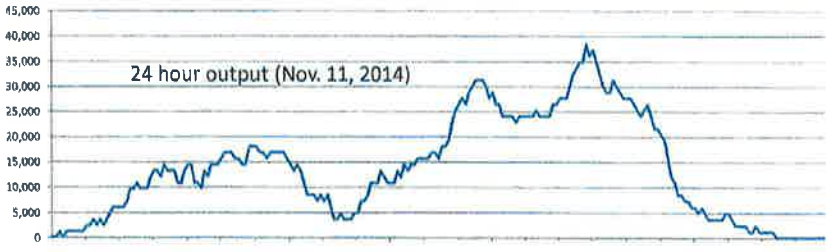
Horse Butte Wind Farm

- Commissioned in 2012
- 32 Vestas V100 turbines
- 1.8 MWe capacity per turbine
- 57.6 MWe total capacity
- 17,600 acres



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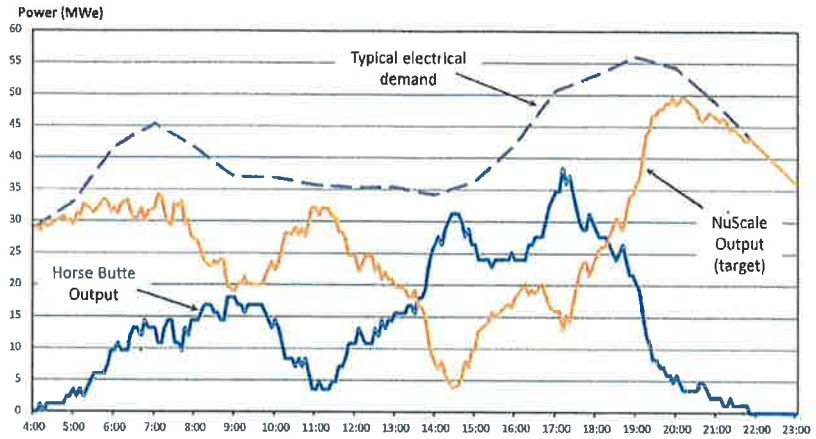
Target Output for NuScale Module



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What Will Project WIN mean to Idaho?

- Establishes INL as key player in SMR deployment
- Creates slipstream for other NuScale projects, both within WIN family and elsewhere worldwide
- Project will create ~1000 construction jobs at peak, for duration of 2-3 years
- Indirect economic benefits and associated job multipliers
- Full-time plant employment ~360 at average salaries $85K
- Indirect economic benefits
- Establishes Idaho as potential desired location for NuScale supply chain members—Premier already working under contract

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What is Needed to Ensure Success in Idaho?

- Need a committed owner/buyer – will ultimately drive site selection decision for first project—UAMPS CFPP
- Project will need to demonstrate sufficient need for/use of generated power
- State should consider doing economic impact study
- Suitable plant economics/investment profile (e.g. long-term PPA's)
- Favorable/supportive local and state permitting and approval processes
- Economic development incentives (ala Eagle Rock?)
- Sufficient capable facility workforce and community interest
- Possible implementation of new federal programs for Port of Lewiston and bridges/roads upgrades on haul route

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Supplier Scope - Minimum

- Fabricate the NuScale Power Module
  - Containment Vessel
  - Reactor Vessel
  - Reactor vessel internals and piping
  - Steam Generator
  - Assembly and testing, including ITAAC
- Install equipment from other OEMs
- For domestic plants with an opportunity for international export
- A plan to increase production to meet demand
- Value > $350M in fabricator scope per plant

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NuScale Plant Needs

EACH 12 MODULE NUSCALE PLANT WILL NEED

- OVER 211,000 CY OF CONCRETE
- OVER 5000 TONS OF STEEL
- OVER 150,000 LINEAR FEET OF PIPE
- OVER 30,000 VALVES
- OVER 7 MILLION LINEAR FEET OF WIRE AND CABLE
- OVER 1.5 MILLION LINEAR FEET OF CONDUIT
- OVER 40,000 LINEAR FEET OF CABLE TRAY
- OVER 12,000 INSTRUMENTS
- OVER 500 ITEMS OF ELECTRICAL EQUIPMENT (SWITCHGEAR, MCC'S, PDC'S, INVERTERS, VFD'S, ETC.)
- OVER 500 MISC. ITEMS OF MECHANICAL EQUIPMENT

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NuEx Tours – NIST, Control Room Simulator and UMM

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